National Aeronautics and Space Administration

Aeronautics

Wind-tunnel force measurement calibration system

In-situ load system (ILS) for calibrating and validating aerodynamic properties of scaled aircraft in ground-based aerospace testing applications

ILS provides the ground-testing community with a comprehensive tool that permits system-level calibration and validation of force measurement systems in a test-like environment. It was developed to improve testing accuracy, repeatability, time in tunnel, and many aspects of the calibration process. The key innovations are that ILS enables a system calibration (rather than independent subsystem and component calibrations) by using the one force vector calibration approach and a statistically defensible estimate total force measurement uncertainty. ILS may be applied in any wind tunnel facility, private or government.

BENEFITS

- Improves aerodynamic measurement accuracy for wind tunnel testing
- Provides a simple, compact, versatile, and self-contained design
- Reduces overall testing cost and time
- Offers robustness that reduces operator and installer errors during set-up, calibration, and testing
- Establishes a process and hardware that could become a standard where none exists
- Provides statistically rigorous estimates of force measurement uncertainty of fully-integrated wind tunnel model system

APPLICATIONS

- Wind tunnel testing

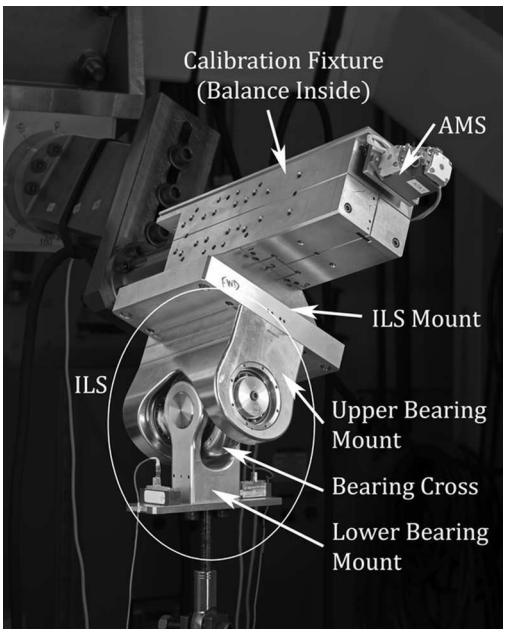
technology solution

THE TECHNOLOGY

During wind-tunnel testing, a balance is used to obtain high-precision measurements of the aerodynamic loads on an aircraft model. Most balance calibrations are conducted in a laboratory environment, where most of the nuisance variables, such as temperature, electrical noise, vibrations, etc., can be controlled. When the instrumentation is transferred to the test environment, the nuisance variables change as well as the behavior of the system. To ensure that the calibration of the balance is still valid for the change in environment, validation checks are conducted in the wind tunnel. Currently, multi-component test environment validation checks are mechanically complex, introduce uncertainties in the applied loads, and are time consuming.

This technology is designed to address the challenge of evaluating wind-tunnel model system performance during test preparation activities. ILS is based on the force-vector concept where a single deadweight load is used to apply up to six loads simultaneously through changing the orientation of the wind-tunnel model system relative to gravity. As the orientation of the force balance changes relative to gravity, the applied load vector that is produced imparts varying load combinations and magnitudes. During typical force-balance checkout, multiple-component loads are not applied although researchers and wind-tunnel customers expect these types of complex loadings during testing. In addition, axial force (aerodynamic drag), which is the aerodynamic component of highest interest, is rarely checked during the checkout process.

ILS permits a more robust evaluation of the laboratory calibration during checkout as opposed to current approaches that are used. Furthermore, since the ILS uses a single load and the design is mechanically simpler than the current checkout hardware, many sources of systematic error are removed from the process.



ILS device

PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

The Technology Gateway

Langley Research Center

Mail Stop 151
Hampton, VA 23681
757-864-1178
LARC-DL-technologygateway@mail.nasa.gov

http://technology.nasa.gov/

www.nasa.gov

NP-2015-08-2020-HQ

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LAR-18318-1